

Amperex[®]



Semiconductor

LDS

*

Actual Size



*LEADLESS INVERTED DEVICES

FOR HYBRID INTEGRATED CIRCUITS

AMPEREX ELECTRONIC CORPORATION
SEMICONDUCTOR AND RECEIVING TUBE DIVISION

SLATERSVILLE, RHODE ISLAND 02876 • 401/POplar 2-9000



Amperex®

Leadless

GENERAL DESCRIPTION

Amperex **LDS** (Leadless Inverted Devices) are micro-miniature semiconductors specifically designed for use in hybrid integrated circuits. Basically, **LDS** consist of a ceramic carrier and silicon chip. The contact areas of the **LDS** are covered with a layer of molybdenum which is gold-plated. Connection of the silicon chip to the gold is performed with normal silicon planar bonding techniques to form a secure silicon-gold eutectic. The chip is wire bonded to the subsurface lands; the active device and wire lands are then covered with a layer of protective material.

MECHANICAL DESCRIPTION

LDS lend themselves to automatic, multiple insertion techniques with simple tools or jigs. Figure 1 illustrates a typical jig holding **LDS** in their proper position prior to substrate attachment. With the jig properly placed over multiple circuits, it can readily be seen that attaching semiconductors to hybrid integrated circuits is now a truly low-cost mass production operation.

A mechanical drawing showing the dimensions of the **LDS** now available is shown in Figure 2. The contact lands are gold plated to a thickness of 200 microinches. Attachment of **LDS** to the substrate should be performed with solder temperatures of 300°C max for 15 seconds maximum. Any high quality flux is suitable.

LDS are color coded by means of a dot on the back corner. In addition to locating the emitter land, the color of the dot identifies the specific **LDS** type. Figure 3 shows the location of this marking.

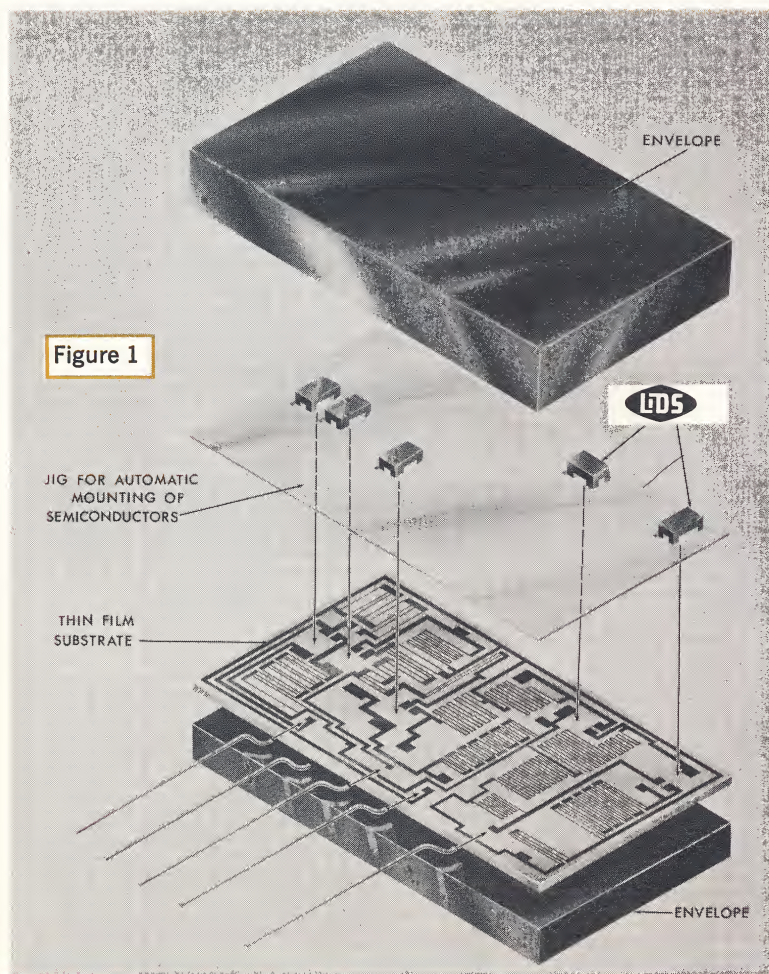


Figure 1

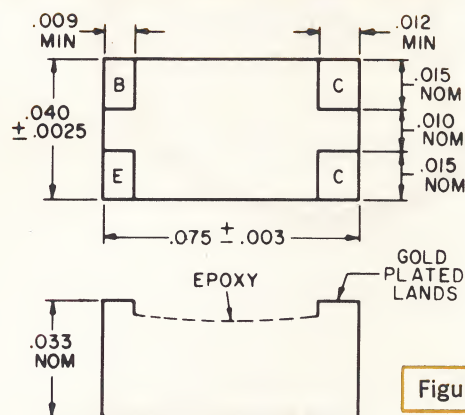


Figure 2

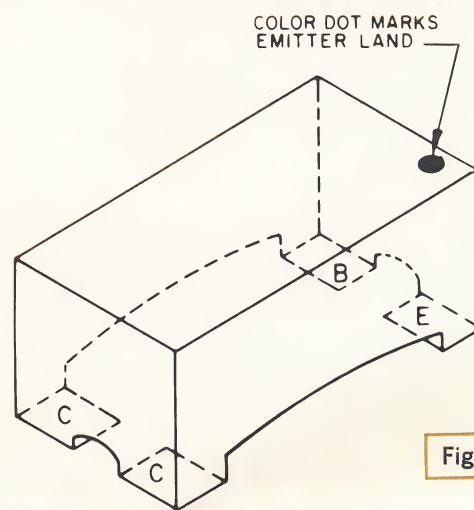


Figure 3



Amperex **LDS** for hybrid integrated circuits offer outstanding advantages which improve circuit yield, increase reliability and reduce manufacturing costs.

- **LDS ARE COMPLETELY CHARACTERIZED**

LDS are supplied with both AC and DC characteristics guaranteed. Therefore, hybrid integrated circuits can be produced in mass quantities to take advantage of completely specified semiconductors.

LDS can be tested readily and graded for important parameters such as gain, speed, noise, etc. to enable linear and digital circuit designers to choose devices that will meet their stringent circuit requirements.

- **LDS ELIMINATE WIRE BONDING TO CIRCUITS**

LDS have no external leads and the hybrid circuit manufacturer does not have to master costly wire bonding techniques. These leadless devices therefore improve mechanical rigidity and circuit reliability.

- **LDS ARE DESIGNED FOR AUTOMATIC MULTIPLE MOUNTING**

LDS were designed for jig loading and automatic mounting.

LDS are marked for easy identification in assembly and their size eliminates the need for expensive micro-optics in establishing a mass production operation.

- **LDS SAVE SPACE AND IMPROVE STABILITY**

LDS are specially designed to save substrate area. The four contact lands take up a minimum of surface space and permit inter-connections and patterns (crossovers) to be run between the lands of the **LD** itself. Because they are mounted rapidly and at low temperature, there is no degradation of the semiconductor characteristics. Furthermore, the passive substrate also remains more stable since it never sees high temperature during the mounting operation.



Available Leadless Inverted Devices

Silicon planar switching and amplifier transistors are now available in production quantities for use in low level, RF, IF, AF and digital applications. Because of the package flexibility afforded with **LDS**, the complete line of small and medium signal planar transistors and diodes will be available in this unique micro-miniature package. Ask Amperex for detailed specifications on **LDS**.

Information on Amperex **LDS** and other Semiconductors is available from these Field Sales Offices and Government Sales Offices:

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301 Belmont St., Belmont, Mass. 02178
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662 Bridgeport Ave., Milford, Conn.
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Box 384, R.D. #2, Dover, Pennsylvania 17315
Tel: 717-292-4071
Resident Office —
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P.O. Box 17566, Charlotte, N. C. 28211

Tel: 704-EM 6-2061

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Tel: 513-224-0561; TWX: 513-944-0298

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Hicksville, L.I., N.Y. 11802

Attn: Distributor Sales Department



Amperex[®] ELECTRONIC CORPORATION
SLATERSVILLE, RHODE ISLAND 02876

TYPES
LDA-402
LDA-403
LTD*
TRANSISTORS

ADVANCE DATA

*LEADLESS INVERTED DEVICE

The Amperex **LTD** types LDA-402 and LDA-403 are NPN silicon planar epitaxial transistors in microminiature ceramic packages intended for general purpose amplifier applications. They offer extremely small package dimensions.

ABSOLUTE MAXIMUM RATINGS (at 25°C Ambient)

	Symbol	Value
Collector-Base Voltage	V_{CBO}	35 volts
Collector-Emitter Voltage	V_{CEO}	35 volts
Emitter-Base Voltage	V_{EBO}	5 volts
Total Transistor Power (see Note #1)	P_T	250 mw
Operating Junction Temperature	T_J	175°C
Storage Temperature	T_{stg}	-65°C to +150°C
Derating Factor (above 25°C free air)	K_θ	1.7 mw/°C

STATIC ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

	Symbol	Min	Max	Units
Collector-Base Leakage Current $V_{CB} = 35\text{V}$	I_{CBO}	-	100	NA
Collector-Emitter Breakdown Voltage $I_C = 10\text{ ma}$	BV_{CEO}	35	-	volts
Emitter-Base Leakage Current $V_{EB} = 5\text{V}$	I_{EBO}	-	100	NA
Collector-Emitter Saturation Voltage $I_C = 1\text{ ma}, I_B = 0.1\text{ ma}$	$V_{CE}(\text{sat})$	-	.25	volts
Base-Emitter Saturation Voltage $I_C = 1\text{ ma}, I_B = 0.1\text{ ma}$	$V_{BE}(\text{sat})$.6	.8	volts
DC Forward Current Gain $I_C = 1\text{ ma}, V_{CE} = 5\text{V}$	h_{FE}	100	300	
	h_{FE}	270	600	

DYNAMIC ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

	Symbol	Min	Typ	Max	Units
Gain Bandwidth Product $V_{CE} = 10\text{V}, I_C = 2\text{ ma}$	f_T	-	250	-	MC
Open Circuit Output Capacitance $V_{CB} = 5\text{V}, f = 1\text{ MC}$	C_{obo}	-	-	6	pf

¹ This rating is dependent on thermal conductivity and size of substrate. 250 MW based on glass substrate 0.1" square.

MOUNTING NOTES

Land areas are gold plated to 100 microinches.
Solder temperature should not exceed 300°C for 15 seconds max.
Any high quality electronic grade flux may be used.

IDENTIFICATION MARKINGS

The emitter land is indicated by a red dot on the reverse side of the transistor (see Figure 1).

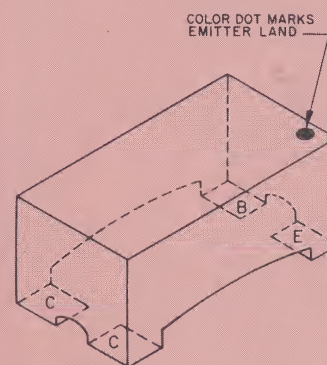
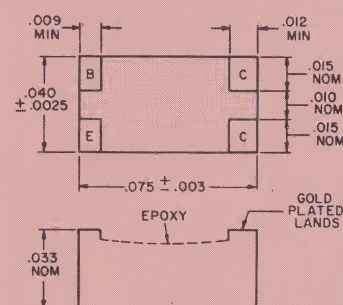
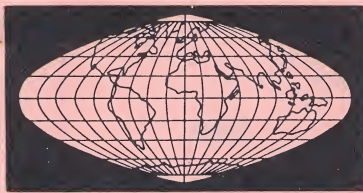


Figure 1

Amperex



Amperex[®] ELECTRONIC CORPORATION
SLATERSVILLE, RHODE ISLAND 02876

TYPES
LDS-200
LDS-201



TRANSISTORS

ADVANCE DATA

*LEADLESS INVERTED DEVICE

The Amperex **LDS** types LDS-200 and LDS-201 transistors are very high speed NPN silicon planar epitaxial transistors in microminiature ceramic packages primarily intended for use in logic switching circuits where high frequency performance capability, medium current handling capacity and extremely small size are essential.

Electrically similar to the 2N2368 and 2N2369 transistors, the LDS-200 and LDS-201 are designed to switch currents from 1 MA to 100 MA.

ABSOLUTE MAXIMUM RATINGS (at 25°C Ambient)

	Symbol	Value
Collector-Base Voltage	V_{CBO}	30 volts
Collector-Emitter Voltage	V_{CEO}	15 volts
Emitter-Base Voltage	V_{EBO}	4.5 volts
Total Transistor Power (see Note #1)	P_T	250 mw
Operating Junction Temperature	T_j	175°C
Storage Temperature	T_{stg}	-65 to +150°C
Derating Factor (above 25°C free air)	K_θ	1.7 mw/°C

STATIC ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

	Symbol	Min	Max	Units
Collector-Base Breakdown Voltage $I_C = 10\mu\text{a}$	BV_{CBO}	30	-	volts
Collector-Emitter Breakdown Voltage $I_C = 10\text{ ma}$, $R_{BE} = 510\ \Omega$ (Pulsed Test: Pulse width 300 μs Duty Cycle $\leq 2\%$)	BV_{CER}	15	-	volts
Base-Emitter Breakdown Voltage $I_E = 10\ \mu\text{a}$	BV_{EBO}	4.5	-	volts
DC Forward Current Gain $I_C = 10\text{ ma}$, $V_{CE} = 1\text{V}$	h_{FE}	20	60	
Type LDS-200	h_{FE}	40	120	
Type LDS-201				

¹ This rating is dependent on thermal conductivity and size of substrate. 250 MW based on glass substrate 0.1" square.

MOUNTING NOTES

Land areas are gold plated to 100 microinches.
Solder temperature should not exceed 300°C for 15 seconds max.
Any high quality electronic grade flux may be used.

IDENTIFICATION MARKINGS

The emitter land is indicated by a yellow dot on the reverse side of the transistor (see Figure 1).

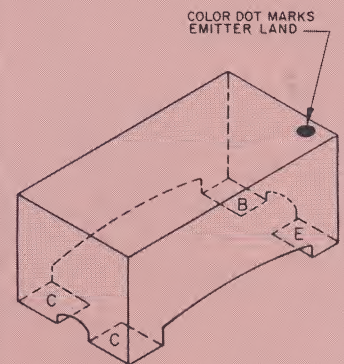
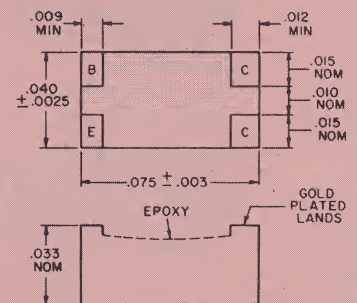


Figure 1

Amperex

STATIC ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted) (Cont.)

	<u>Symbol</u>	<u>Min</u>	<u>Max</u>	<u>Units</u>
Collector-Emitter Saturation Voltage $I_C = 10\text{ ma}, I_B = 1\text{ ma}$	$V_{CE}(\text{sat})$	-	.30	volts
Collector-Base Saturation Voltage $I_C = 10\text{ ma}, I_B = 1\text{ ma}$	$V_{BE}(\text{sat})$.70	.85	volts
Collector-Base Cut-Off Current $V_{CB} = 20\text{ V}$	I_{CBO}	-	500	NA
Emitter-Base Cut-Off Current $V_{CB} = 20\text{ V}, T_A = 125^\circ\text{C}$	I_{CBO}	-	25	μa
Emitter-Base Cut-Off Current $V_{EB} = 4.5\text{ V}$	I_{EBO}	-	500	NA

DYNAMIC ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

	<u>Symbol</u>	<u>Min</u>	<u>Typ</u>	<u>Max</u>	<u>Units</u>
Frequency at which $ h_{fe} = 1$ $I_C = 10\mu\text{a}, V_{CE} = 10\text{ V}$	f_T	500	-	-	Mc
Storage Time Constant $I_C = IB_1 = IB_2 = 10\text{ ma}$	t_s	-	8	13	N sec
Turn-off time $I_C = 10\text{ ma}, I_B = 3\text{ ma}$ $IB_2 = 1.5\text{ ma}$	t_{off}	-	13	18	N sec
Open Circuit Output Capacitance $V_{CB} = 5\text{ V}, f = 1\text{ Mc}$	C_{obo}	-	-	4	pf
Open Circuit Input Capacitance $V_{EB} = 1\text{ V}, f = 1\text{ Mc}$	C_{ibo}	-	-	4.5	pf



Amperex[®] ELECTRONIC CORPORATION
SLATERSVILLE, RHODE ISLAND 02876

TYPES
LDA-400
LDA-401
LTD*
TRANSISTORS

ADVANCE DATA

*LEADLESS INVERTED DEVICE

The Amperex **LTD** types LDA-400 and LDA-401 are NPN silicon planar epitaxial transistors in micro-miniature ceramic packages. Similar electrically to the 2N929 and 2N930, these devices are primarily intended for applications where low noise and low level amplification and extremely small size are essential.

ABSOLUTE MAXIMUM RATINGS (at 25°C Ambient)

	Symbol	Value
Collector-Base Voltage	V_{CB0}	35 volts
Collector-Emitter Voltage	V_{CEO}	35 volts
Emitter-Base Voltage	V_{EBO}	5 volts
Total Transistor Power (see Note #1)	P_T	250 mw
Operating Junction Temperature	T_j	175°C
Storage Temperature	T_{stg}	-65 to +150°C
Derating Factor (above 25°C free air)	K_θ	1.7 mw/°C

STATIC ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

	Symbol	Min	Max	Units
Collector-Base Leakage Current $V_{CB} = 10\text{V}$	I_{CB0}	-	10	na
Collector-Emitter Breakdown Voltage $I_C = 10\text{ ma}$	BV_{CEO}	35	-	volts
Emitter-Base Leakage Current $V_{EB} = 5\text{ V}$	I_{EBO}	-	10	na
Collector-Emitter Saturation Voltage $I_C = 1\text{ ma}$ $I_B = 0.1\text{ ma}$	$V_{CE}(\text{sat})$	-	.25	volts
Base-Emitter Saturation Voltage $I_C = 1\text{ ma}$ $I_B = 0.1\text{ ma}$	$V_{BE}(\text{sat})$.6	.8	volts
D.C. Forward Current Gain $I_C = 10\text{ }\mu\text{a}$, $V_{CE} = 5\text{ V}$ LDA-400	h_{FE}	40	120	
$I_C = 100\text{ }\mu\text{a}$, $V_{CE} = 5\text{ V}$ LDA-400		75	-	
$I_C = 10\text{ }\mu\text{a}$, $V_{CE} = 5\text{ V}$ LDA-401	h_{FE}	100	300	
$I_C = 100\text{ }\mu\text{a}$, $V_{CE} = 5\text{ V}$ LDA-401		120	-	

¹ This rating is dependent on thermal conductivity and size of substrate 250 MW based on glass substrate 0.1" square.

MOUNTING NOTES

Land areas are gold plated to 100 microinches.
Solder temperature should not exceed 300°C for 15 seconds max.
Any high quality flux may be used.

IDENTIFICATION MARKINGS

The emitter land is indicated by a red dot on the reverse side of the transistor (see Figure 1).

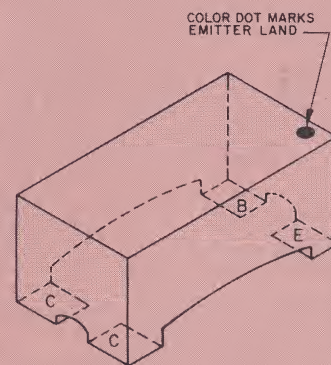
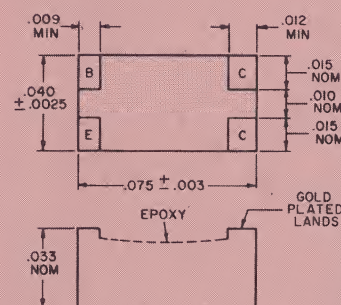


Figure 1

Amperex

DYNAMIC ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

	<u>Symbol</u>	<u>Min</u>	<u>Typ</u>	<u>Max</u>	<u>Units</u>
Gain Bandwidth Product					
$V_{CE} = 5\text{V}, I_C = 500\ \mu\text{a}$	f_T	30	-	-	Mc
$V_{CE} = 10\text{V}, I_C = 2\text{ma}$	f_T	-	250	-	Mc
Open Circuit Output Capacitance					
$V_{CB} = 5\text{V}, f = 1\text{ Mc}$	C_{obo}	-	-	6	pf
Noise Figure					
$I_C = 10\ \mu\text{a}, V_{CE} = 5\text{V}, f = 1\text{Kc}$	NF	-	3	-	db
$R_S = 10\text{ K}\Omega$					
$I_C = 10\ \mu\text{a}, V_{CE} = 5\text{V}$	NF	-	2	-	db
$BW = 10\text{ cps} - 15.7\text{ Kc}$					
$R_S = 10\text{ K}\Omega$					



AMPEREX ELECTRONIC CORPORATION

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TWX. 516-433-9045

Cable Address:

"Ampronic, Hicksville"

Dear Sir:

Per your request, we are pleased to enclose detailed specifications on Amperex **LDS** (leadless inverted devices).

LDS are Amperex silicon planar semiconductors in a micro-miniature package specifically designed for hybrid integrated circuits.

LDS attachment can be mechanized, resulting in lower assembly costs and improved yields.

LDS are fully specified semiconductors enabling the circuit designer to improve hybrid integrated circuit performance. The

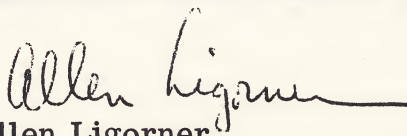
LDS semiconductor types described in the attached literature are now available in production quantities.

PNP complements to the existing **LDS** families will be available shortly. In addition, diodes and RF transistors electrically similar to the Amperex A415, A472 and 2N918 will be available in **LDS**

Please feel free to contact us or our sales representative listed below if further information is required.

Very truly yours,

AMPEREX ELECTRONIC CORPORATION



Allen Ligorner
Product Specialist
Microelectronics

Enclosure

cc:



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